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# Identifying mentoring practices for developing effective primary science teaching

*Peter Hudson*

*Queensland University of Technology*

Victoria Park Road

Kelvin Grove QLD 4059

Australia

CRICOS No 00213J

Phone: +738643345

Fax: +738643985

Email: pb.hudson@qut.edu.au

**Abstract**

A literature-based survey gathered 331 final-year preservice teachers' perceptions of their mentoring in primary science education from nine Australian universities. Data were analysed within five factors proposed for mentoring (i.e., Personal Attributes, System Requirements, Pedagogical Knowledge, Modelling, and Feedback). Results indicated that the majority of mentors (primary teachers) did not provide specific mentoring in primary science, particularly in the science teaching practices associated with the factors System Requirements, Pedagogical Knowledge, and Modelling. This study argues that mentors may require further education to learn how to mentor specifically in primary science, and proposes a specific mentoring intervention as a way forward for developing the mentor's mentoring and teaching of primary science.

# Identifying mentoring practices for developing effective primary science teaching

## Introduction

All preservice teachers deserve an equal opportunity to learn how to teach primary science, which occurs pragmatically with mentors (primary teachers) in professional experience settings (Jasman, 2002). However, the majority of primary teachers may not be confident in teaching primary science (Mulholland, 1999; National Science Standards, 2002) let alone mentoring in this field. Mentoring can be a way to develop teaching practices (Crowther & Cannon, 1998), as it provides opportunities for mentors and mentees to engage in pedagogical discourse and reflective thinking. Mentoring has become more prominent in teacher education (Power, Clarke, & Hine, 2002), which increases the responsibilities assigned to mentors (Sinclair, 1997). This has implications for the primary teacher, as there are several key learning areas in the primary school that generalist primary teachers are expected to teach, and it is likely that these teachers will not have expertise in all areas. For example, many generalist primary teachers either teach science inadequately or not at all (Goodrum, Hackling, & Rennie, 2001). Therefore, primary teachers who become mentors may not have mentoring expertise to effectively guide the mentee's learning across all key learning areas, and this includes primary science.

Modelling and articulating effective practices are key aspects of mentoring; however "non-expert" mentors of primary science may not be able to model or discuss effective science teaching practices. Preservice teachers need "coaching" to transform idealistic concepts about teaching into more operational practices, and those who are coached perform decidedly better than the "uncoached", particularly in teaching instruction and classroom management skills (Veenman, 1995).

Just as teachers can always improve their methods of teaching, so too can mentors improve their methods of mentoring. Primary teachers in their roles as mentors need to have an "understanding of scientific knowledge and scientific methods" in order to implement effective mentoring programs in science (Hodson & Hodson, 1998, p. 23). There have been opportunities in various countries for primary teachers to develop science knowledge and methods of mentoring. For example, New York State Department of Education offered educational opportunities to teachers through workshops, seminars, and courses with specific mentoring skills being taught (Ware, 1992). The New South Wales Department of Education and Training has also educated a small number of teachers on becoming mentors (NSW DET, 2003). Although these courses aimed to provide mentoring strategies, not all potential or existing mentors are prepared to participate in a mentoring training course. Hulshof and Verloop's study (1994) reports that 74% of mentors felt that education in mentoring was necessary but considered such education more important for new mentors. As curricula continually changes, teachers are required to develop further understandings and skills in order to advance their practices. Similarly, mentors also need to ensure that their understandings and skills are current.

Gaston and Jackson (1998) claim that mentors must be thoroughly educated on explicit mentoring practices with mentor programs that are well organised. Undoubtedly, teachers need to be formally prepared for their roles as mentors, as in most cases “mentors are thrust into the new role of mentoring with only the most meagre guidance” (Edwards & Collison, 1996, p. 11). Mentors “need explicit training in the stimulation of novice teachers to reflect on their actions in order to move them to higher levels of professional thinking” (Veenman, de Laat, & Staring, 1998, p. 6). Indeed, mentors can be agents of change (Edwards & Collison, 1996), but may require further education themselves with specific objectives for developing mentoring practices in subjects such as primary science (Jarvis, McKeon, Coates, & Vause, 2001).

**Using objectives to provide specific feedback for mentees**

Preservice teachers are learners and “learners need goals” (Edwards & Collison, 1996, p. 11). Mentoring preservice teachers should be an intentional process, as a formal mentoring program increases the likelihood of achieving the mentee’s needs (Ackley & Gall, 1992). Researchers (Christensen, 1991; Griffin, 1985; McLaughlin, 1993; Monk & Dillon, 1995; Showers & Joyce, 1996) stress that mentors need specific objectives as a focus for providing feedback. Mentors require further education on establishing clear and obtainable objectives so that mentoring specific subjects such as science becomes more purposeful (Hudson, 2002). Furthermore, feedback will be more useful if it addresses the mentee's needs in relation to the objectives that aim at producing effective primary science teaching (Hudson, 2004; Jarvis et al., 2001). Objectives that are linked to indicators of effective practices may provide directions for both mentors and mentees (preservice teachers), and provide a way to gather evidence on the achievement of such objectives.

**Educating mentors towards effective mentoring in primary science teaching**

Mentors require specific education on the subject they are mentoring (e.g., Hodge, 1997), which is particularly the case for primary education (Jarvis et al., 2001). Although some mentoring can emerge naturally, educators need to ensure that mentoring is not left to chance (Ganser, 1996); hence it is necessary to plan the learning experiences for mentoring (Weaver & Stanulis, 1996). A major part of the mentor's role in primary education is to develop the mentee's overall teaching ability, yet each mentor has individual beliefs on what is and what is not important. These individual mentor views will vary on all aspects of teaching and mentoring, from the planning through to the choice of classroom procedures for implementing a primary science teaching strategy. Coates, Vause, Jarvis, and McKeon (1998, p. 9) state that teachers' experience of "mentoring and their experience of teaching science vary widely", and that mentors generally do not receive specific mentoring training in primary science. Yet, primary teachers who have been educated in science mentoring are more confident in raising issues, expect specific learning outcomes, place greater emphasis on pedagogical knowledge, and aim to improve their own skills of observing primary science teaching practices (Jarvis et al., 2001).

**Model for mentoring in primary science teaching**

Five factors for mentoring have previously been identified (Hudson & Skamp, 2003a; see Figure 1), namely, personal attributes (Ackley & Gall, 1992; Ganser, 1996), system requirements (Bybee, 1997; Jarvis et al., 2001), pedagogical knowledge (Kesselheim, 1998; Mulholland, 1999), modelling (Crowther & Cannon, 1998; Monk & Dillon, 1995), and feedback (Power et al., 2002; Showers & Joyce, 1996), and items associated with each factor have also been identified and justified with the literature (Hudson & Skamp, 2003b; Hudson, Skamp, & Brooks, 2005).

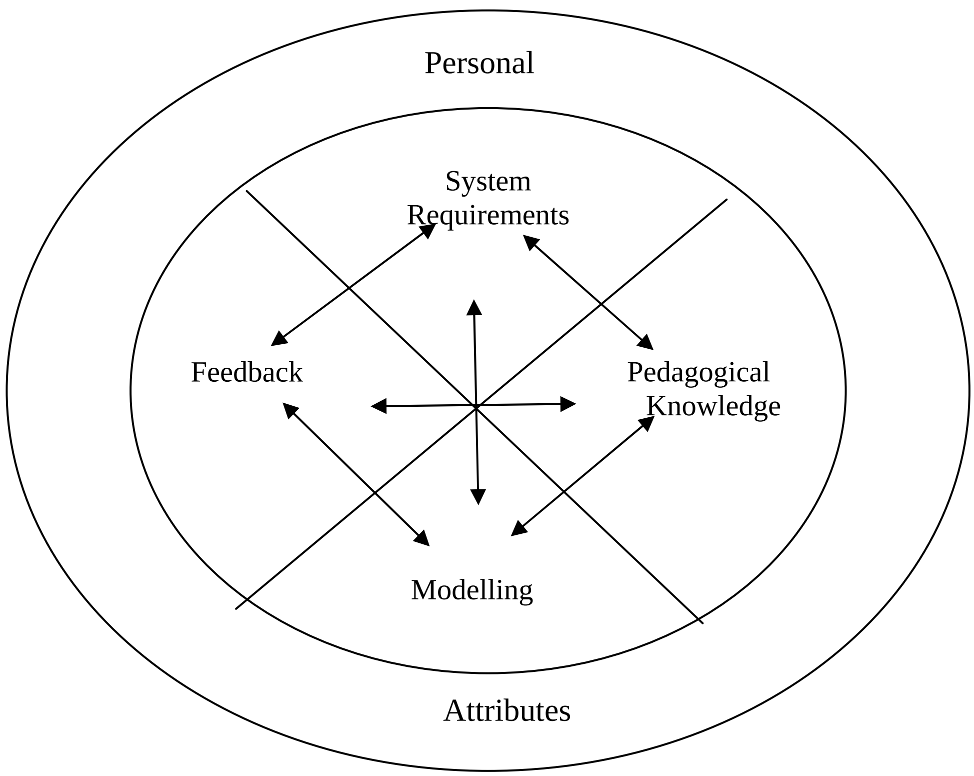


Figure 1. *Five-factor mentoring model*

**Purpose of this study**

This study explores and describes final-year preservice teachers' perceptions of their mentoring in primary science education within five factors (i.e., system requirements, pedagogical knowledge, modelling, and feedback) linked to a literature-based survey instrument.

**Data collection method and analysis**

The "Mentoring for Effective Primary Science Teaching" (MEPST) survey instrument in this study evolved through a series of preliminary investigations on mentoring for effective primary science teaching. Steps for developing and validating the survey instrument included small-scale interviews with mentors and mentees (*n*=10) on their perceptions of mentoring preservice primary science teaching at the conclusion of a three-week professional experience. The literature-based survey instrument was pilot tested on 21 first-year preservice teachers (Hudson, 2003) and later with 59 final-year preservice teachers (Hudson & Skamp, 2003a) at the conclusion of their professional experiences. Analysis of these pilot tests provided data for refining the instrument to be administered to a wider sample of final-year preservice teachers (*n*=331).

The survey instrument contained items that were linked to literature-based mentoring practices. For example, Item 3 (factor: Modelling) stated, "During my final professional school experience (i.e., internship/practicum) in primary science teaching my mentor modelled effective classroom management when teaching science." Responses to these items were on a five-part Likert scale (i.e., strongly disagree=1, disagree=2, uncertain=3, agree=4, strongly agree=5). The data were previously subjected to a confirmatory factor analysis (CFA; see Hair, Anderson, Tatham, & Black, 1995), which defined a relationship between the variables (items) assigned to each factor (see Hudson et al., 2005). For this study, data were analysed within each of the five factors (i.e., Personal Attributes, System Requirements, Pedagogical Knowledge, Modelling, and Feedback) and descriptive statistics (i.e., percentages, mean scores, and standard deviations) were derived using SPSS for each variable.

## Results and discussions

The 331 complete responses (284 female; 47 male) from final-year preservice teachers (mentees) received from nine Australian universities provided data on the five factors and descriptors of the participants (mentors and mentees) in each of the five factors and associated variables. These mentees' perceptions of their mentoring in primary science were responses on the survey instrument gathered at the conclusion of their final professional experience (i.e., practicum/field experience).

### *Descriptors of mentees (final-year preservice teachers)*

Fifty-six percent of these mentees (*n*=331) entered teacher education straight from high school, with 52% completing biology units at school. All mentees had completed at least one science methodology unit at university, and all mentees had completed at least three block professional experiences (practicums) with 28% completing five professional experiences. There were no professional experiences under a three-week duration, and 66% of professional experiences were of a five-week duration or more.

Only 49% of these mentees were required to teach science during professional experiences as part of their university requirements; however the number of science lessons taught by mentees varied considerably (11% taught one lesson; 6% two lessons; 22% three or four lessons; 38% six lessons or more; and 15% did not teach science at all).

*Descriptors of mentors (primary teachers)*

Most mentors were over 40 years old, although 17% were under 30 years of age. Mentees indicated that 27% of mentors did not have an “interest” or a “strong interest” in science. Forty percent of mentors did not model a science lesson during their mentees’ professional experiences, which may equate to the 40% of mentees who considered science not “a strength” of the mentors. Eleven percent of mentors did not talk about science during the total professional experience, and 45% of mentors spoke to their mentees about primary science teaching a maximum of three times during their final professional experience.

*Five factors*

The five factors were analysed through confirmatory factor analysis with acceptable Cronbach alphas for each, that is, Personal Attributes (mean score=3.14, *SD* [standard deviation]=1.08), System Requirements (mean score=2.29, *SD*=0.93), Pedagogical Knowledge (mean score=2.76, *SD*=1.01), Modelling (mean score=3.09, *SD*=1.07), and Feedback (mean=3.14, *SD*=1.11) were .93, .76, .94, .95, and .92 respectively. The following provides specific data on the attributes and practices associated with each factor.

*Personal Attributes.*

The findings on the mentees' perceptions of the six mentoring attributes and practices associated with the Personal Attributes factor indicated a significant number of mentors who did not provide these particular Personal Attributes (mean item score range: 2.72 to 3.46; *SD* range: 1.22 to 1.31, Table 1). For example, 36% of mentors were perceived not to be supportive of their mentees' development in primary science teaching (Table 1). Perhaps these mentors lacked confidence or lacked sufficient knowledge of primary teaching and/or specific subject mentoring. This is consistent with the findings that the teaching of primary science is largely inadequate in many Australian schools as reported in Goodrum et al. (2001).

Mentors' personal attributes may aid in developing the mentee's reflective skills (Desouza & Czerniak, 2003). However, assisting mentees to reflect on primary science teaching practices had the lowest rating for the Personal Attributes factor with only 35% of mentors perceived to provide this practice (Table 1). The ability to reflect is fundamental to effective science teaching because it enables teachers to improve upon their practices (Desouza & Czerniak, 2003). Mentors may need to improve on mentoring reflective practices so that mentees can be assisted to reflect on their own primary science teaching.

Table 1

*"Personal Attributes" for mentoring primary science teaching*

| Mentoring Practices | %* | Mean score | *SD* |
|---|---|---|---|
| Supportive | 64 | 3.46 | 1.31 |
| Comfortable in talking | 56 | 3.30 | 1.22 |
| Attentive | 53 | 3.19 | 1.31 |
| Instilled confidence | 46 | 3.10 | 1.28 |
| Instilled positive attitudes | 45 | 3.07 | 1.23 |
| Assisted in reflecting | 35 | 2.72 | 1.25 |

* %=Percentage of mentees who either "agreed" or "strongly agreed" their mentor provided that specific mentoring practice.

There were also mentors who were perceived to demonstrate limited or no Personal Attributes, who may mentor subsequent preservice teachers. Hence, if these mentors are to improve, they will need to be provided with mentoring strategies that focus on specific personal attributes. The mentor's Personal Attributes can affect the perceived mentoring of the other four factors (i.e., System Requirements, Pedagogical Knowledge, Modelling, and Feedback) and contributes significantly to the mentoring process.

*System Requirements.*

The findings indicated that over 75% of mentees perceived that their mentors did not provide mentoring practices associated with these System Requirement items (mean item score range: 2.22 to 2.40; *SD* range: 1.07 to 1.11, Table 2). For example, although aims are emphasised for general teaching practices and mandated as a system requirement, 77% of mentors in this study were perceived not to discuss with their mentees the aims for teaching primary science (Table 2). Similarly, 82% of mentors were perceived not to outline the primary science curriculum to their mentees, and 84% of mentors did not discuss primary science school policies with their mentees (Table 2). These mentors were responsible for the mentee's understanding of aims, curriculum, and policies.

Table 2

*"System Requirements" for mentoring primary science teaching*

| Mentoring Practices | %* | Mean score | *SD* |
|---|---|---|---|
| Discussed aims | 23 | 2.40 | 1.11 |
| Outlined curriculum | 18 | 2.27 | 1.11 |
| Discussed policies | 16 | 2.22 | 1.07 |

* %=Percentage of mentees who either "agreed" or "strongly agreed" their mentor provided that specific mentoring practice.

As most mentees perceived they were not mentored on System Requirements, many final-year preservice teachers about to enter the profession may not be aware of aims, curriculum, or policies for teaching primary science. Even though universities have a key role in educating preservice teachers on System Requirements, this essential aspect of primary science education reform needs to be implemented at the professional experience level. Indeed, before preservice teachers enter the profession, there must be some assurance they understand the System Requirements in the school setting associated with an educational system. However, this does not seem to be apparent within the majority of mentoring experiences (Table 2).

Even at this foundational level of learning about System Requirements, mentees received minimal mentoring experiences towards planning for their science teaching experiences. Not taking into account previous professional experiences and tertiary education, more than three quarters of primary teachers due to enter the profession may have no or little practical understanding of mandatory requirements such as science aims, science curriculum, and science policies. Implementing departmental directives and primary science education reform by beginning practitioners will not occur without clear input at the professional experience level. In addition, mentors' guidance for developing preservice teachers' understanding of System Requirements can assist toward implementing departmental directives associated with teaching primary science.

*Pedagogical Knowledge.*

The findings indicated that mentees' perceptions of their mentoring experiences of Pedagogical Knowledge varied considerably between them (mean item score range: 2.60 to 2.91; *SD* range: 1.10 to 1.32, Table 3). For example, a descending rank order of frequencies of the 11 Pedagogical Knowledge practices, which mentees agreed or strongly agreed that their mentors articulated such mentoring, revealed that the highest ranked practice of mentors was science lesson preparation (Table 3). Even as the highest ranked practice, 55% of mentees perceived they had not received guidance for primary science lesson preparation. At the lowest end of the rank order, only 25% of mentors were perceived to provide problem solving strategies for teaching primary science (Table 3). Thus, as many as 75% of mentees appeared not to have received comprehensive mentoring on the items associated with Pedagogical Knowledge for primary science teaching.

Table 3

*"Pedagogical Knowledge" for mentoring primary science teaching*

| Mentoring Practices | %* | Mean score | *SD* |
|---|---|---|---|
| Guided preparation | 45 | 2.87 | 1.27 |
| Assisted with timetabling | 44 | 2.91 | 1.27 |
| Assisted with classroom management | 44 | 2.85 | 1.32 |
| Assisted with teaching strategies | 41 | 2.86 | 1.23 |
| Assisted in planning | 37 | 2.72 | 1.23 |
| Discussed implementation | 35 | 2.70 | 1.19 |
| Discussed knowledge | 35 | 2.73 | 1.19 |
| Provided viewpoints | 35 | 2.81 | 1.23 |
| Discussed questioning techniques | 31 | 2.67 | 1.21 |
| Discussed assessment | 31 | 2.64 | 1.22 |
| Discussed problem solving | 25 | 2.60 | 1.10 |

* %=Percentage of mentees who either "agreed" or "strongly agreed" their mentor provided that specific mentoring practice.

It seems evident that mentees' opportunities for developing their primary science teaching will be significantly limited if mentors fail to adequately articulate their pedagogical knowledge. Hence, pedagogical knowledge linked to science education reform may not be promoted (e.g., Bybee, 1997). Indeed, mentees need to understand practices associated with Pedagogical Knowledge for their development as beginning practitioners (e.g., Hulshof & Verloop, 1994; Mulholland, 1999). Generally, mentors will require either further education on mentoring the practices associated with Pedagogical Knowledge or a framework to facilitate the articulation of these Pedagogical Knowledge practices for development of mentees' primary science teaching.

*Modelling.*

Modelling teaching provides mentees with visual and aural demonstration of how to teach, yet despite acknowledging the benefits of modelling practices, the majority of mentors were perceived not to model primary science teaching in this study (mean item score range: 2.68 to 3.41; *SD* range: 1.22 to 1.41, Table 4). For example, even though mentors regard classroom management as vital to professional experience programs and mentors claimed that they needed to model classroom management (Ganser, 1996), 57% of final-year preservice teachers perceived they had not experienced this modelling during their professional experience program (Table 4). Similarly, 44% of mentors were perceived to demonstrate well-designed primary science lessons, which was the same percentage as those who modelled science teaching.

Mentors demonstrated slightly more well-designed lessons than hands-on lessons during the mentees' professional experience program; hence the perception of well-designed lessons appears not to solely involve hands-on experiences for students. For example, well-designed lessons can include the structure of the lesson rather than a component of the lesson (e.g., a hands-on experience). As most final-year preservice teachers have three professional experiences, and if the previous two professional experiences provided no modelling of hands-on science lessons in the primary classroom, then a significant number of beginning teachers may not have been exposed to the modelling of a hands-on science lesson with primary students as participants in a classroom environment.

Table 4

*"Modelling" primary science teaching*

| Mentoring Practices | % | Mean score | *SD* |
|---|---|---|---|
| Modelled rapport with students | 58 | 3.36 | 1.24 |
| Displayed enthusiasm | 48 | 3.08 | 1.23 |
| Modelled a well-designed lesson | 44 | 3.09 | 1.26 |
| Modelled science teaching | 44 | 2.68 | 1.25 |
| Modelled classroom management | 43 | 2.96 | 1.30 |
| Modelled effective science teaching | 42 | 3.11 | 1.22 |
| Demonstrated hands-on | 41 | 3.01 | 1.26 |
| Used syllabus language | 40 | 3.04 | 1.22 |

* %=Percentage of mentees who either "agreed" or "strongly agreed" their mentor provided that specific mentoring practice.

Mentees need mentors to model effective teaching practices, and those who have not observed the mentor's modelling of primary science teaching tend to rely on their own experiences as a student in primary and secondary science classes (e.g., Mulholland, 1999), which can impact on implementing current primary science education reform. Incorporating the eight attributes and practices associated with the Modelling factor can assist mentors to more readily facilitate the mentees' learning of primary science teaching and aid the reform process. In addition, mentors who experience Modelling of primary science teaching may also develop their own teaching practices. Hence, targeting mentors and mentees through a specific mentoring intervention that includes modelling specific primary science teaching practices can lead to improved mentoring practices (e.g., see Hudson, P., & McRobbie, 2003). Fine tuning mentoring practices may also lead to implementing primary science education reform.

*Feedback.*

The need for providing this feedback is strongly supported by the literature on generic mentoring (e.g., Edwards & Collison, 1996; Monk & Dillon, 1995; Power et al., 2002; Showers & Joyce, 1996), and is also supported for specific subject mentoring (e.g., Jarvis et al., 2001). Although the findings indicated that observing mentees' primary science teaching was perceived as the highest ranked Feedback practice employed by mentors (74%), only 12% of mentors were perceived not to provide oral feedback after observing the mentee teach primary science (mean item score ranage: 2.75 to 3.72; *SD* range: 1.23 to 1.38, Table 5). There was a 20% difference between observing the mentee's science teaching and reviewing the mentee's lesson plans. Thus, as many as 20% of mentors may have observed their mentees teach primary science without reviewing their lesson plans. Although 62% of mentors were perceived to provide oral feedback, the duration or nature of this feedback is unknown.

Table 5

*Providing "Feedback" on primary science teaching*

| Mentoring Practices | % | Mean score | *SD* |
|---|---|---|---|
| Observed teaching for feedback | 74 | 3.72 | 1.37 |
| Provided oral feedback | 62 | 3.32 | 1.28 |
| Reviewed lesson plans | 54 | 3.13 | 1.32 |
| Provided evaluation on teaching | 46 | 2.96 | 1.29 |
| Provided written feedback | 45 | 2.95 | 1.38 |
| Articulated expectations | 33 | 2.75 | 1.23 |

* %=Percentage of mentees who either "agreed" or "strongly agreed" their mentor provided that specific mentoring practice.

Most mentees perceived their mentors did not articulate of expectations, provide written feedback, or assist the mentee to evaluate primary science teaching practices (Table 5). The fact that these evaluative components of effective mentoring practices were not in evidence in so many cases (e.g., 66% mentors were perceived not to articulate their expectations for primary science teaching; Table 5) indicated a lack of adequate direction of mentees in signalling expectations and providing critical analysis. Indeed, these mentees may be planning without knowledge of departmental, school and community expectations for teaching primary science. The findings further indicated that 29% of mentors who were perceived to observe their mentees' teach did not provide written feedback. Mentors need to provide written feedback to ensure mentees have a record of their science teaching performance and a way to reflect on teaching practices. Arguably, it may be that oral feedback is easier to provide than written feedback, which is reflected in the percentage of mentors who provided each in this study (Table 5).

As feedback of mentees' teaching practices can address a mentoring program's objectives, and aids in enhancing primary science teaching practices (Jarvis et al., 2001), the effectiveness of primary science teaching and learning may be diminished if mentors do not provide feedback to their mentees. Indeed, mentees who perceived that they had not received feedback from their mentors, even if it were provided, indicated that either these mentors require further education on providing feedback or the clarity of such mentoring was questionable. Thus, the identification of the six attributes and practices associated with the Feedback factor can assist mentors in providing more comprehensive feedback. Primary science education reform relies on developing pedagogical knowledge and system requirements in teaching practices (Bybee, 1997), and mentors who do not provide feedback on primary science teaching practices will not be articulating necessary reform measures (i.e., pedagogical knowledge or system requirements) for enhancing their mentees' practices.

**Summary and conclusions**

This study explores and describes final-year preservice teachers' perceptions of their mentoring in primary science education within five factors (i.e., Personal Attributes, System Requirements, Pedagogical Knowledge, Modelling, and Feedback). These findings do not consider mentees' previous experiences or that mentors may not have provided these mentoring practices because they felt the mentees had already acquired those skills. Mentees may be skilled in particular science teaching areas and consequently did not receive specific mentoring as these skills may have been noted by the mentor. For example, although only a quarter of mentors assisted mentees in problem solving strategies for teaching science, this may not have been necessary for all mentees. Some mentees may have displayed knowledge of problem solving, were prepared for teaching, and therefore did not require mentoring in this area. However, this appears unlikely as on average less than half the mentors modelled science teaching practices in this study, which may indicate a lack of confidence from mentors to adequately display their science teaching skills and knowledge. Despite this possible limitation, mentees cannot be considered expert enough that they do not require further mentoring in any of the areas linked to the MEPST survey instrument. It is the mentor's role to ensure that mentees receive full experiences regardless of assumed or previous articulation of experiences. It should be the mentor's role to extend the mentees' experiences in areas of perceived successful practices. An effective mentor can scaffold the mentee's learning and raise the standard of teaching science in all aspects of the mentee's teaching by addressing specific mentoring issues.

The study was limited by the research methods and inclusion of key participants. For example, qualitative research methods can provide further insight into this study's findings. In addition, further investigations on both mentees and mentors' perceptions would provide a clearer picture of mentoring practices in primary science.

Expert primary science teachers who are skilled in mentoring would be best suited as mentors for preservice teachers of science, and *this* is the crux of the mentoring problem, that is, educating primary teachers to be sufficiently skilled in mentoring for effective primary science teaching. Indisputably, “generalist” primary teachers will not be experts in all subjects in primary school, however, they teach in subject areas where they are not experts. To illustrate, primary teachers teach art without being artists, music without being musicians, and various sports without being experts in those particular sports, and aim to address the syllabi outcomes for each area. Likewise, teachers can be called upon to mentor in subject areas where they are not experts, which may allow them to further develop their teaching skills in these fields. Nevertheless, if preservice teachers are to receive quality mentoring in primary science teaching then teachers, in their roles as mentors, may require further education. The form this education takes will require further investigation, as primary teachers may be reluctant to be educated on their mentoring practices (e.g., Hulshof & Verloop, 1994).

The majority of preservice teachers will not receive equitable mentoring in primary science teaching, however, mentees claim that the in-school context is pivotal to their development as teachers (Gaffey, Woodward, & Lowe, 1995; Jasman, 2002). This study argues that for mentees to receive adequate mentoring in primary science teaching requires a set of specific mentoring skills to be included in mentors’ practices. Final-year preservice teachers’ perceptions of their limited mentoring in primary science may be initially addressed through a specific mentoring intervention that focuses on each of the items associated with the MEPST instrument. Additionally, tertiary institutions may employ the MEPST instrument to gauge the degree and quality of mentoring in primary science and, as a result of diagnostic analysis, plan and implement mentoring programs that aim to address the specific needs of mentors in order to enhance the mentoring process. The MEPST instrument can be used to assist mentors in their education on specific primary science mentoring and as a way to measure and enhance their own mentoring practices.

Utilising the mentor's time efficiently is crucial for developing the mentee's practices in primary science, and this is further justification for educating mentors. The mentor's involvement in facilitating the mentee's learning for more effective primary science teaching cannot be indiscriminate; instead it must be predetermined and sequentially organised so that the mentor's objectives are focused, specific, clear, and obtainable, which means educating mentors. A possible way forward is educating mentors through expert mentors who are recognised for their expertise in both mentoring and teaching in order to have credibility within the teaching profession. Therefore, expert mentors may also need to: display personal attributes, understand system requirements, model effective mentoring (which also requires modelling effective teaching practices), and provide pedagogical knowledge and feedback towards enhancing mentoring practices. Indeed, the five factors for mentoring in primary science teaching may be the same factors required of mentor educators. Educating mentors aims at ultimately targeting the development of more effective science teaching practices, and hence a way to enhance students' learning experiences.

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Note: A copy of the MEPST instrument is available from Dr Peter Hudson (email: pb.hudson@qut.edu.au)

Appendix 1

# Mentoring for Effective Primary Science Teaching (MEPST)

*(This survey is to be conducted after the mentoring experience)*

**SECTION 1:** This section aims to find out some information about you. To preserve your anonymity, write your mother's maiden name on this survey. Thank you for your participation in this important study on your mentoring. Please ***circle*** the answers that apply to you.

**Mother's maiden name:**_______________________________________

**a)** What is your sex? Male Female

**b)** What is your age? <22 yrs 22 - 29 yrs 30 - 39 yrs >40 yrs

**c)** What science units did you complete in Years 11 and 12 at high school?

(Please list, for example, 2 unit biology, 2 unit physics, 2 unit chemistry, etc.)

_______________________________________________________________________

**d)** How many primary science curriculum/methodology units did you complete at university?

0 1 2 3 4 or more

**e)** How many block practicums have you now completed during your tertiary teacher education? (including this one). 1 2 3 4 5 or more

**SECTION 2:** This section aims to find out about this last practicum/internship. Please ***circle*** the answer you feel is most accurate.

**a)** What is your mentor's sex? Male Female

**b)** What was your mentor's approximate age during this last practicum?

<22 yrs 22 - 29 yrs 30 - 39 yrs >40 yrs

**c)** How many science lessons did **you** teach during your last practicum/internship?

0 1 2 3 4 5 6 or more

**d)** How many science lessons did your **mentor** teach during this last practicum/internship?

0 1 2 3 or more

**e)** Would primary science be one of your mentor's strongest subjects?

Strongly agree Agree Unsure Disagree Strongly disagree

**SECTION 3:** The following statements are concerned with your mentoring experiences in primary science teaching during your last practicum/internship. Please indicate the degree to which you agree or disagree with each statement below by circling the appropriate number to the right of each statement.

## Key

**SD** = Strongly Disagree
**D** = Disagree
**U** = Uncertain
**A** = Agree
**SA** = Strongly Agree

**During my final field school experience (i.e., internship/practicum) in primary science teaching my <u>mentor</u>:**

| | | | | | |
|---|---|---|---|---|---|
| 1. was supportive of me for teaching science. ………………………… | SD | D | U | A | SA |
| 2. used science language from the current primary science syllabus. | SD | D | U | A | SA |
| 3. guided me with science lesson preparation. …………..…………… | SD | D | U | A | SA |
| 4. discussed with me the school policies used for science teaching. .. | SD | D | U | A | SA |
| 5. modelled science teaching. ………………………………………….. | SD | D | U | A | SA |
| 6. assisted me with classroom management strategies for science teaching. | SD | D | U | A | SA |
| 7. had a good rapport with the primary students doing science. …… | SD | D | U | A | SA |
| 8. assisted me towards implementing science teaching strategies. …. | SD | D | U | A | SA |
| 9. displayed enthusiasm when teaching science. …………………..…. | SD | D | U | A | SA |
| 10. assisted me with timetabling my science lessons. ……………….. | SD | D | U | A | SA |
| 11. outlined state science curriculum documents to me. ……………. | SD | D | U | A | SA |
| 12. modelled effective classroom management when teaching science. | SD | D | U | A | SA |
| 13. discussed evaluation of my science teaching. …………………….. | SD | D | U | A | SA |
| 14. developed my strategies for teaching science. …………………… | SD | D | U | A | SA |
| 15. was effective in teaching science. ………………………………… | SD | D | U | A | SA |
| 16. provided oral feedback on my science teaching. ………………….. | SD | D | U | A | SA |

| | | | | | |
|---|---|---|---|---|---|
| 17. seemed comfortable in talking with me about science teaching. …. | SD | D | U | A | SA |
| 18. discussed with me questioning skills for effective science teaching. | SD | D | U | A | SA |
| 19. used hands-on materials for teaching science. ……………………. | SD | D | U | A | SA |
| 20. provided me with written feedback on my science teaching. …… | SD | D | U | A | SA |
| 21. discussed with me the knowledge I needed for teaching science. .. | SD | D | U | A | SA |
| 22. instilled positive attitudes in me towards teaching science. ……… | SD | D | U | A | SA |
| 23. assisted me to reflect on improving my science teaching practices. | SD | D | U | A | SA |
| 24. gave me clear guidance for planning to teach science. …………… | SD | D | U | A | SA |
| 25. discussed with me the aims of science teaching. ………………….. | SD | D | U | A | SA |
| 26. made me feel more confident as a science teacher. ……………… | SD | D | U | A | SA |
| 27. provided strategies for me to solve my science teaching problems. | SD | D | U | A | SA |
| 28. reviewed my science lesson plans before teaching science. ………. | SD | D | U | A | SA |
| 29. had well-designed science activities for the students. ……………. | SD | D | U | A | SA |
| 30. gave me new viewpoints on teaching primary science. ………….. | SD | D | U | A | SA |
| 31. listened to me attentively on science teaching matters. ………….. | SD | D | U | A | SA |
| 32. showed me how to assess the students' learning of science. …….. | SD | D | U | A | SA |
| 33 clearly articulated what I needed to do to improve my science teaching. … | SD | D | U | A | SA |
| 34. observed me teach science before providing feedback. ………….. | SD | D | U | A | SA |